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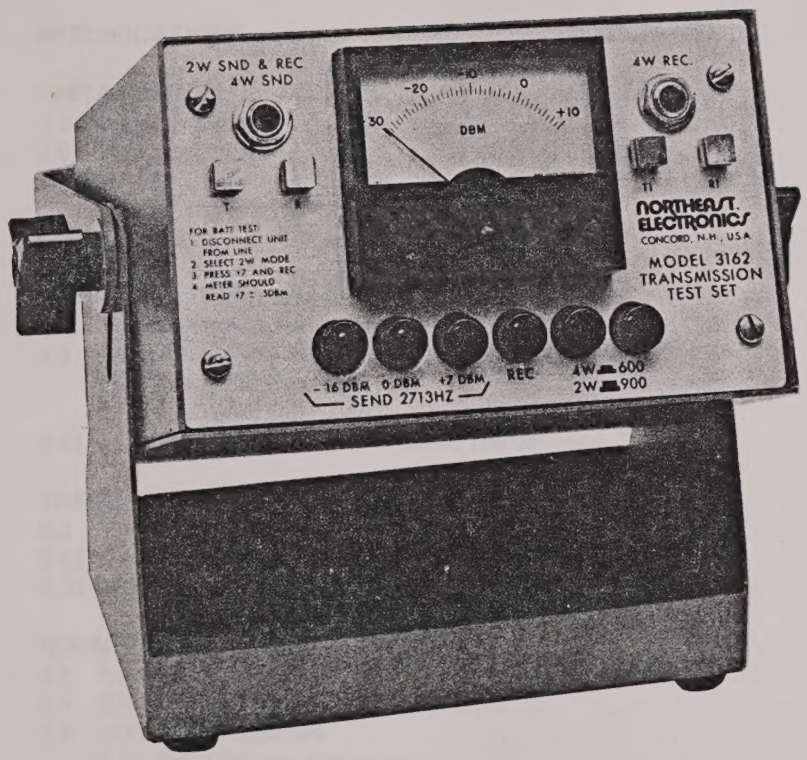
3162

transmission test set

NORTHEAST 3162



NORTHEAST ELECTRONICS

A DIVISION OF NORTHERN TELECOM, INC.

INSTRUCTION MANUAL

MODEL 3162
TRANSMISSION TEST SET

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SECTION 1

GENERAL DESCRIPTION

1.1 This manual describes the Northeast Electronics Model 3162 Transmission Test Set. The 3162 is a small, portable instrument principally used at telephone central offices as an activator unit for the Northeast Electronics 3160 Series Loop Test System. The 3162 unit may also be used as a basic transmission level test set.

1.2 MODEL 3162 APPLICATIONS

1.3 The complete 3160 Series Loop Test System is designed to permit fast, convenient testing of special service loops, from a telephone central office, without travel to subscriber locations. The Model 3162 allows a central office craftsman to remotely control other units of the system which are installed at the subscriber ends of special service loops.

1.4 Using the Model 3162 as an activator, the craftsman can command any one of the system's remote units to disconnect customer owned and maintained (COAM) equipment from a loop. The craftsman can then use the Model 3162 to test the loop from his central office position to the remote unit at the subscriber location.

1.5 To initiate testing on any equipped loop, the central office craftsman uses the 3162 to transmit a 2713-Hz interrogation tone into the loop. A remote Loop Test Unit (LTU) at the subscriber location then:

1. Receives the interrogation tone;

2. Disconnects the COAM equipment at its location;

3. Terminates the COAM equipment interface with an optional, customer supplied impedance;

4. Cooperates with the central office craftsman in testing the loop's ac and dc characteristics;

5. Reconnects the COAM equipment to the loop after a fixed time elapses.

1.6 With the remote LTU activated, the central office craftsman can check a loop's transmission loss, continuity, resistance, and other parameters. The Model 3162 unit used at the central office has basic send/receive level test features to aid in measurements on the loop.

1.7 Both 2-wire and 4-wire loops can be handled by the system. Each 2-wire loop to be covered by the system must have a Model 3160 Loop Test Unit installed at the subscriber end. Each 4-wire loop to be covered by the system must have a Model 3161 Loop Test Unit installed at the subscriber end. The Model 3162 activator unit, used at the central office, can handle both 2-wire and 4-wire loops.

1.8 When a 2-wire LTU (Model 3160) is interrogated, it disconnects COAM equipment then couples to the loop:

1. A 680-Hz test tone at 0 dBm into 900 ohms;

2. A 33-kohm dc test termination.

1.9 The Model 3162 activator can measure the 680-Hz test signal level received at the central office to determine loop transmission loss. Such dc parameters as continuity and resistance can be checked using other equipment at the central office. The 2-wire LTU automatically restores normal service on the loop about 30 seconds after it was interrogated.

1.10 When a 4-wire LTU (Model 3161) is interrogated, it disconnects COAM equipment then:

1. Creates an ac test loop-back path between the loop's receive and send pairs;

2. Couples 33-kohm dc test terminations to the loop's receive and send pairs.

1.11 The 3162 activator can then measure its own 2713-Hz test tone looped back by the 4-wire LTU to determine total transmission loss of the loop's send and receive pairs. Continuity, resistance, and other dc parameters of each pair can be measured using other equipment at the central office. The 4-wire LTU automatically restores normal service on the loop about 60 seconds after it was interrogated.

1.12 In addition to the above loop test system applications, the Model 3162 activator can be used as a basic transmission level test set. (A 1004-Hz send frequency is available on special order for this purpose.)

1.13 MODEL 3162 FEATURES

1.14 The Model 3162 is essentially a send/receive test set that can be used on either 2-wire or 4-wire circuits. Front panel pushbuttons allow selection of −16, 0, or +7 dBm (± 0.3 dB) send levels into either 600 or 900 ohms. The send frequency is 2713 ± 5 Hz. (A1004 Hz send frequency is optionally available on special order.)

1.15 The receive section can measure signals from −30 to +10 dBm with ±0.2 dB accuracy on both 600-ohm and 900-ohm circuits. Receive section bandpass is 300 Hz to 3 kHz. Receive level measurements are obtained from a front panel meter having a linear scale from −30 to +10 dBm in 1 dB steps.

1.16 Telephone circuits can connect to the Model 3162 via front panel jacks or square binding posts. For permanent installation, a terminal board is provided on the rear panel for telephone circuit connections.

1.17 The Model 3162 is powered by its own internal battery supply or by central office battery. Central office battery connects to the rear panel terminal board. The condition of the battery supply can be conveniently tested by pressing the appropriate front panel pushbuttons.

1.18 The Model 3162 is a compact, portable instrument having a front panel cover for storage and shipping, and a bail handle for carrying. The front panel cover is swivel mounted to the case to serve as a support for the test set when used on a horizontal surface. When the test set is used in this manner it can be slanted toward the user as desired to allow accurate reading of the front panel meter.

1.19 A hanger bracket is supplied with the test set to allow permanent mounting to a type 3 or similar test board. This bracket attaches to the test set bail. When this mounting arrangement is used, the test set can be rotated and slanted toward the user as desired to allow accurate reading of the front panel meter. Other brackets are available to allow mounting in 19 inch or 23 inch racks.

SECTION 2

SPECIFICATIONS

2.1 Table 2—1 lists specifications for the Model 3162 Transmission Test Set.

Table 2—1. Model 3162 Transmission Test Set Specifications.

SEND SECTION	
Send Frequency:	2713 ± 5 Hz. (1004 ± 5 Hz available on special order.)
Send Levels:	−16, 0, +7 dBm ± 0.3 dB; selectable from front panel.
Send Section Impedance:	600 or 900 ohms ± 10% at 2713 Hz; selectable from front panel.
RECEIVE SECTION	
Measure Level Range:	−30 to +10 dBm.
Measure Level Accuracy:	±0.2 dB as read on meter.
Frequency Range:	300 Hz to 3 kHz.
Receive Section Impedance:	600 or 900 ohms ± 10% at 1000 Hz; selectable from front panel.
Front Panel Meter:	Linear scale from −30 to +10 dBm in 1 dB steps.
CONNECTORS	Type 310 jacks and square binding posts on front panel. Screw-type terminal strip on rear panel. Seperate connectors for send and receive sections when 4-wire operation selected.
INPUT POWER	
Internal:	Three 216-type 9V batteries to produce 27V. Test set operates per specifications for battery voltage range of 18 to 30V.
External:	42 to 56 Vdc at 20 mA (nominal current drain). When test set is not in use, approximately 0.5 mA of current is drawn from external source.
OPERATING ENVIRONMENT	
Operating Temperature:	32°F to 122°F (0°C to 50°C).
Storage Temperature:	−40°F to 167°F (−40°C to 75°C).
Relative Humidity:	10 to 95 percent.

Table 2—1. (cont'd).

MECHANICAL

Size:	6¾ in w x 4¼ in h x 7 in d. (17.1 cm x 10.8 cm x 17.8 cm.)
Weight:	4 pounds (1.8 kg).
Mounting:	Can be used as portable instrument or can be permanently mounted via 8 inch hanger bracket provided. Other brackets are available to allow mounting in 19 inch or 23 inch racks.

SECTION 3

INSTALLATION

3.1 This section contains inspection and installation information.

3.2 VISUAL INSPECTION

3.3 The test set is shipped with a front panel cover and a bail type handle attached. Detached from the test set should be an 8-inch hanger bracket.

3.4 Loosen knobs at each side of unit to allow front cover to be swung away from front panel. Inspect the bail, cover, and test set exterior for damage incurred during shipment. A visual inspection for the test set interior is not necessary.

3.5 PRE-INSTALLATION CHECKOUT

3.6 To determine if the test set was shipped without internal damage, perform the following steps.

1. Be sure that no telephone lines are connected to the test set and that the 4W/2W pushbutton is released.

2. Simultaneously press both the +7 DBM and REC pushbuttons. The test set meter should read +7 ± 0.5 dBm.

3. Release the +7 DBM pushbutton and press the 0 DBM pushbutton while still holding the REC pushbutton. The test set meter should read 0 ± 0.5 dBm.

4. Release the 0 DBM pushbutton and press the −16 DBM pushbutton while still holding the REC pushbutton. The meter should read −16 ± 0.5 dBm.

3.7 Successful completion of the previous procedure indicates the test set was received without internal damage and is ready for installation and use.

3.8 INSTALLATION

3.9 If the test set is to be used as a portable unit, no installation is necessary. When used as a portable unit, the front panel cover serves to support the test set on a horizontal surface. When the test set is used in this manner, it can be slanted toward the user as desired to allow accurate reading of the front panel meter. Tightening the knobs on each side of the unit locks the test set firmly in place.

3.10 The test set can be permanently mounted to a type 3 or similar testboard via the hanger bracket supplied with the unit. When this type of mounting arrangement is desired, removal of the front panel cover is recommended. To remove the cover, remove the knobs on each side of the unit. After removing the knobs, remove the bail and the cover. Replace bail and all washers before replacing knobs.

3.11 Two slots are provided at one end of the hanger bracket for mounting screws that attach the bracket to the testboard or other desired support. Suitable mounting screws must be supplied by the user. After the hanger bracket is mounted to its support, a captive screw attaches the test set bail to the bracket as shown in Figure 3−1. Figure 3−1 also shows the major dimensions of this mounting arrangement.

3.12 When the test set is mounted as shown in Figure 3−1, it can be rotated and slanted toward the user as desired to allow accurate reading of the front panel meter. When the test set is positioned as desired, tighten the knobs at each side of the unit to hold it in place.

3.13 The terminal board at the rear of the unit can be used for permanent telephone line connections. The terminals on the rear are wired in parallel with the front panel jacks. Connections should be made to the terminals according to the functions described in Table 4−1 and pictured in Figure 4−1.

3.14 The test set can be mounted in 19 inch or 23 inch racks if desired. Optional brackets are available for this purpose.

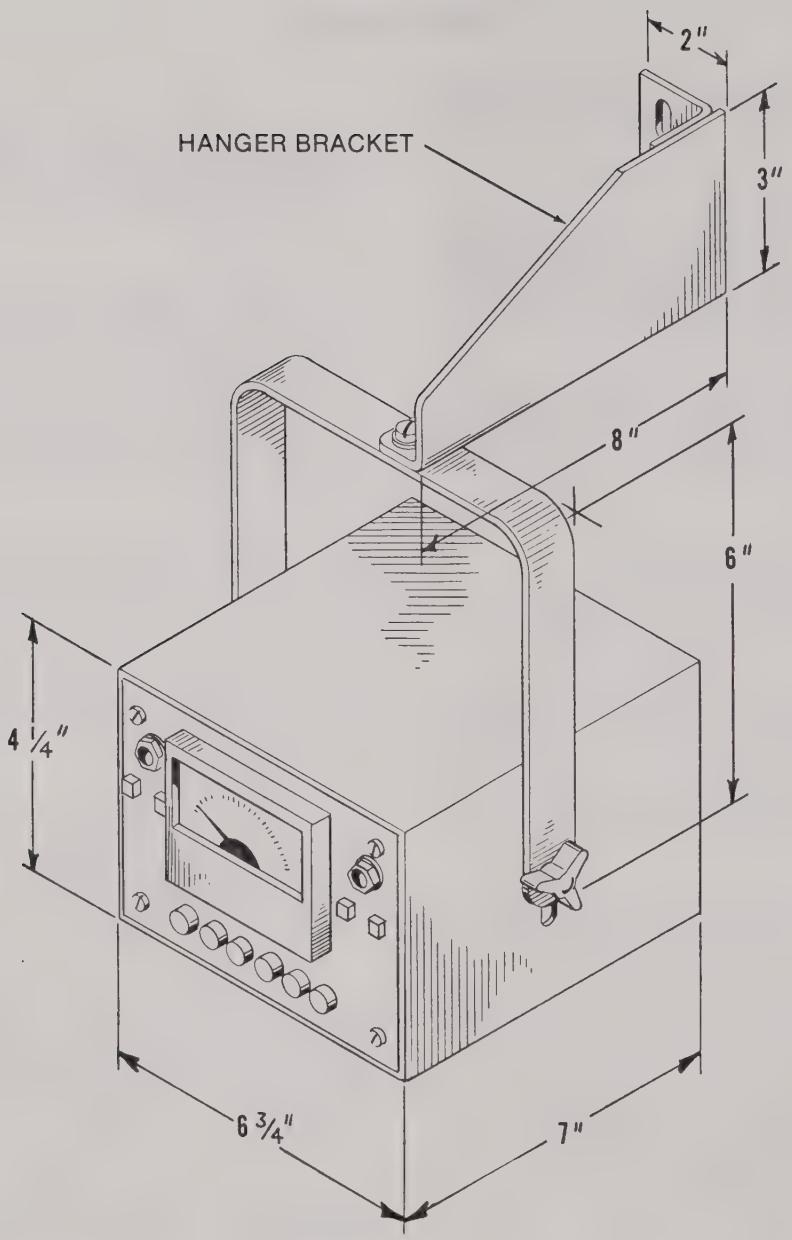


Figure 3—1. Model 3162 Transmission Test Set Installation Diagram.

SECTION 4

OPERATION

4.1 This section contains operating information for the Model 3162 Transmission Test Set.

4.2 CONTROLS, INDICATORS, AND CONNECTORS

4.3 The functions of all Model 3162 controls, indicators, and connectors are described in Table 4—1. The controls, indicators, and connectors are identified in Figure 4—1.

4.4 PREPARATION FOR USE

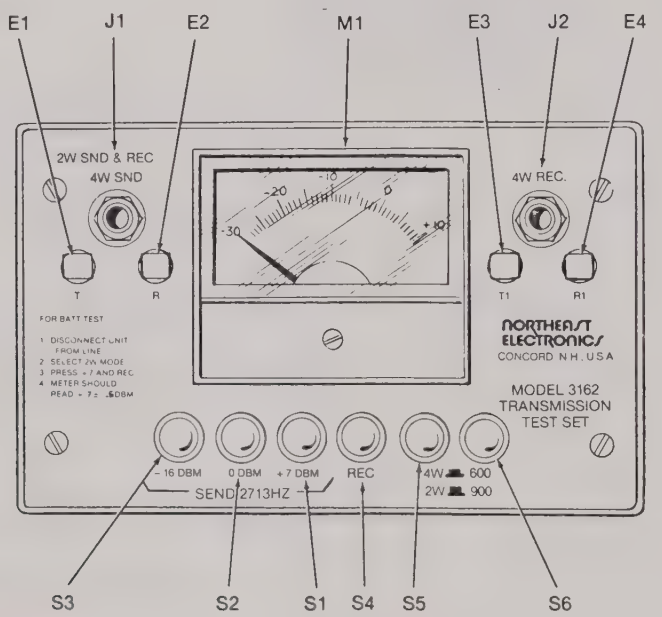
4.5 If the test set is to be powered by an external source from 42 to 56 Vdc (such as central office battery), be sure the source is connected to the rear panel POWER terminals. When an external source between 42 and 56 Vdc is connected to these terminals, the internal battery supply is automatically disabled. If the external source drops to 40 Vdc, the battery supply automatically begins to serve as the test set power source. When the test set is not in use, approximately 0.5 mA of current is drawn from the external source.

Table 4—1. Controls, Indicators, And Connectors.

REF DESIG	CONTROL, INDICATOR OR CONNECTOR	FUNCTION
E1/E2, J1, TB1	2W SND & REC 4W SND	Balanced, dc blocked, access to test set send and receive sections for 2-wire operation. Balanced, dc blocked access to test set send section for 4-wire operation.
E3/E4, J2, TB1	4W REC	Balanced, dc blocked access to test set receive section for 4-wire operation.
M1	Front panel meter	Analog readout for level measurements. Meter has linear scale from −30 to +10 dBm in 1 dB increments.
S1	+7 DBM	When engaged, energizes test set and places a 2713 Hz signal at +7 dBm on 2W SND & REC 4W SND connectors.
S2	0 DBM	When engaged, energizes test set and places a 2713 Hz signal at 0 dBm on 2W SND & REC 4W SND connectors.
S3	−16 DBM	When engaged, energizes test set and places a 2713 Hz signal at −16 dBm on 2W SND & REC 4W SND Connectors.
S4	REC	When engaged, energizes test set and connects 2W SND & REC 4W SND connectors to test set receive section if 2-wire operation selected. This switch is normally not used during 4-wire operation.
S5	4W/2W	Configures the test set for either 2-wire or 4-wire operation. When in the 2W (released) position, enables the 2W SND & REC 4W SND connectors to be connected to either the test set send or receive section. The 4W (engaged) position connects the 2W SND & REC 4W SND connectors to the send section, and the 4W REC connectors to the receive section.

Table 4—1. (cont'd).

REF DESIG	CONTROL, INDICATOR OR CONNECTOR	FUNCTION
S6	600/900	Selects either 600-ohm or 900-ohm send section and receive section impedances. Also controls the send section output level for proper operation on either 600-ohm or 900-ohm circuits.
TB1	POWER	Terminals for central office battery (42 to 56 volts dc) input power. When external source between 42 and 56 Vdc is connected to these terminals, internal battery supply is automatically disabled. If external source drops to 40 Vdc, the battery supply serves as test set power source.



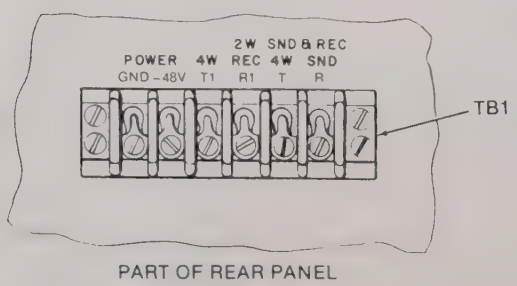


Figure 4—1. Controls, Indicators, And Connectors.

4.6 Before operating the test set, the following operational check should be performed. This procedure checks the battery supply when the test set is not operating from an external source. For convenience, battery test information is given on the front panel. To check the operating condition of the test set, perform the following steps.

1. Be sure that no telephone lines are connected to the test set and that the 4W/2W pushbutton is released.

2. Simultaneously press both the +7 DBM and REC pushbuttons. The test set meter should read +7 ± 0.5 dBm.

3. Release the +7 DBM pushbutton and press the 0 DBM pushbutton while still holding the REC pushbutton. The test set meter should read 0 ± 0.5 dBm.

4. Release the 0 DBM pushbutton and press the −16 DBM pushbutton while still holding the REC pushbutton. The meter should read −16 ± 0.5 dBm.

4.7 If no difficulty was encountered during the previous procedure, the test set is ready for use. If the test set is powered by the internal battery supply and the requirement of step 2 is not met, either the batteries are defective or the test set is out of calibration. If steps 3 and 4 are not performed successfully or step 2 is not performed successfully when an external power source is used, the test set is out of calibration. Battery replacement information is given in paragraph 6.4. Calibration information is given in paragraph 6.6.

4.8 USING THE MODEL 3162 IN THE 3160 SERIES LOOP TEST SYSTEM

4.9 TWO-WIRE OPERATION

4.10 When the 3160 series Loop Test System is used to test a 2-wire special service circuit, a Model 3160 serves as the remote loop test unit. To obtain accurate results, the Model 3160 should be used only on circuits having 900 ohms impedance. To test a 900-ohm 2-wire special service circuit, perform the following steps.

1. Connect the circuit under test to the Model 3162 2W SND & REC 4W SND jack, binding posts or terminals as desired.

2. Set 4W/2W pushbutton to 2W (released position).

3. Set 600/900 pushbutton to 900 (released position).

4. Select either −16 dBm, 0 dBm or +7 dBm send level (as required) by pressing the appropriate pushbutton. A level greater than −30 dBm into 900 ohms is required at the far end of the circuit under test to activate the Model 3160. Hold the selected pushbutton for at least 10 seconds then release.

5. The Model 3160 at the far end should now be activated thereby isolating customer owned and maintained (COAM) equipment from the circuit under test. Press the REC pushbutton to measure the 680-Hz test signal provided by the Model 3160. The meter on the Model 3162 should read 0 dBm ± 1 dB minus the loss in the circuit under test.

NOTE

Other test equipment may be used in place of the Model 3162 if desired. The Model 3160 will remain activated for approximately 30 seconds. After this time period elapses, the circuit under test will be automatically returned to its normal state.

6. Tests can be repeated as many times as desired by pressing the appropriate SEND 2713HZ pushbutton for at least 10 seconds.

4.11 FOUR-WIRE OPERATION

4.12 When the 3160 series Loop Test System is used on a 4-wire special service circuit, a Model 3161 serves as the remote loop test unit. To obtain accurate results, the Model 3161 should be used only on circuits having 600 ohms impedance. To test a 600-ohm 4-wire special service circuit, perform the following steps.

1. Connect the send pair of the circuit under test to the Model 3162 2W SND & REC 4W SND jack, binding posts or terminals as desired.

2. Connect the receive pair of the circuit under test to the 4W REC jack, binding posts or terminals as desired.

3. Set 4W/2W pushbutton to 4W (engaged position).

4. Set 600/900 pushbutton to 600 (engaged position).

5. Select either −16 dBm, 0 dBm or +7 dBm send level as required by pressing the appropriate pushbutton. A level greater than −30 dBm into 600 ohms is required at the far end of the circuit under test to activate the Model 3161. Hold the selected pushbutton for at least 10 seconds, then proceed to step 6 while still holding the pushbutton.

6. The Model 3161 at the far end should now be activated thereby isolating customer owned and maintained (COAM) equipment from the circuit under test. The Model 3161 provides an ac loop-back path between the send and receive pairs when activated. Hence, the

Model 3162 is now measuring its own transmitted signal. The Model 3162 meter should read the transmitted level minus the combined loss of both the send and receive pairs of the circuit under test.

NOTE

Other test equipment may be used in place of the Model 3162 if desired. The Model 3161 will remain activated for approximately 60 seconds. After this time period elapses, the circuit under test will be automatically returned to its normal state.

7. Tests can be repeated as many times as desired by pressing the appropriate SEND 2713HZ pushbutton for at least 10 seconds.

4.13 USING THE MODEL 3162 AS A BASIC TRANSMISSION TEST SET

4.14 When used as a general purpose transmission test set, the Model 3162 can measure signals from −30 to +10 dBm at frequencies from 300 Hz to 3 kHz. The Model 3162 can send a 2713-Hz test signal at either −16, 0 or +7 dBm into either 900 or 600 ohms. The Model 3162 can be equipped with a specially ordered 1004-Hz send frequency. Both 2-wire and 4-wire circuits having an impedance of 600 or 900 ohms can be conveniently tested with the Model 3162.

4.15 The following paragraph describes typical transmission tests on 2-wire circuits. For 4-wire circuits, refer to paragraph 4.17

4.16 To perform transmission tests on a 2-wire circuit, perform the following steps.

1. Connect the circuit to be tested to the 2W SND & REC 4W SND jack, binding posts, or terminals as desired.

2. Set 4W/2W pushbutton to 2W (released position).

3. Set 600/900 pushbutton to either 600 (engaged) or 900 (released) position depending on the impedance of the circuit under test.

4. Press the REC pushbutton to measure a signal from the far end on the Model 3162 meter.

5. Press the appropriate pushbutton to send a test signal at either −16, 0 or +7 dBm as desired.

4.17 To perform transmission tests on a 4-wire circuit, perform the following steps.

1. Connect the send pair of the circuit under test to the 2W SND & REC 4W SND jack, binding posts, or terminals as desired.

2. Connect the receive pair of the circuit under test to the 4W REC jack, binding posts, or terminals as desired.

3. Set 4W/2W pushbutton to 4W (engaged position).

4. Set 600/900 pushbutton to either 600 (engaged) or 900 (released) position depending on the impedance of the circuit under test.

5. To simultaneously send a signal on the send pair while measuring a signal on the receive pair (via the Model 3162 meter), press either the −16 DBM, 0 DBM or +7 DBM pushbuttons depending on the desired send level. If the send and receive pairs of the circuit under test are ac-connected at the far end, the Model 3162 will measure its own test signal.

6. Press the REC pushbutton to measure a test signal (via the Model 3162 meter) on the receive pair without sending a test signal on the send pair.

SECTION 5

THEORY OF OPERATION

5.1 This section describes the Model 3162 internal circuits. Refer to Figure 7—1, the Model 3162 Transmission Test Set Block Diagram, for aid in understanding the following description.

5.2 As shown by Figure 7—1, the Model 3162 consists of a send section, receive section and power circuits. The send section produces an activation/test signal as selected by front panel pushbuttons. The receive section measures the level of signals applied to its input. The power circuits supply the required voltages for the send and recieve sections.

5.3 SEND SECTION CIRCUIT DESCRIPTION

5.4 The Model 3162 send section is essentially a 2713-Hz oscillator having selectable output level and impedance. The 2713-Hz oscillator (consisting of a variable gain amplifier, limiter and tuning fork resonator) is shown at the top left on Figure 7—1.

5.5 The limiter and tuning fork resonator form the feedback loop required for oscillation. The limiter restricts the input to the resonator to approximately 600 mV p-p. This provides level stability for the oscillator.

5.6 Piezoelectric resonator Y1 serves as the frequency controlling element for the oscillator. The minimum gain of amplifier U1A is sufficient to cause resonator Y1 to oscillate at its resonant frequency, 2713 Hz. The resulting 2313-Hz oscillator output, at the output of amplifier U1A, can be monitored at test point TP1. Send level adjust potentiometer R2/R3 controls amplifier U1A's gain to set the oscillator output level for calibration purposes.

5.7 On special order, a Model 3162 test set can be equipped with a specially ordered tuning fork resonator that oscillates at 1004 Hz to produce a 1004 Hz send frequency.

5.8 The 2713-Hz oscillator output undergoes voltage division before application to amplifier U1B. The voltage divider ratio is altered when 600/900 pushbutton S6 is at 600. This reduces the input to amplifier U1B slightly to produce the proper test set output level for testing 600-ohm circuits.

5.9 Except when either 0 DBM pushbutton S2 or +7DBM pushbutton S1 is engaged, amplifier U1B provides the proper voltage gain to produce a −16 dBm (into either 600 or 900 ohms) test set output level. Engaging either the 0 DBM or +7 DBM pushbutton increases amplifier U1B's voltage gain to produce the corresponding test set output level. Amplifier U1B's voltage gain for each of these operating conditions is shown on Figure 7—1.

5.10 Amplifier U1B's output is switched to output transformer T1 whenever +7 DBM pushbutton S1, 0 DBM pushbutton S2, or −16 DBM pushbutton S3 is engaged. 600/900 pushbutton S6 selects the proper series resistance for transformer T1 primary to reflect either 600 ohms or 900 ohms impedance into the send section output circuit. Capacitor C7 and transformer T1 provide a balanced, dc-blocked output for the test set send section.

5.11 The send section output is switched to 2W SND & REC 4W SND connectors J1, E1/E2 and TB1 whenever +7 DBM pushbutton S1, 0 DBM pushbutton S2, or −16 DBM pushbutton S3 is engaged. If 4W/2W pushbutton S5 is at 2W, the send section output can be switched to the receive section input when desired. This allows the test set to measure its own test signal to check battery condition and calibration. Placing the 4W/2W switch in the 4W position, isolates the send section from the receive section.

5.12 RECEIVE SECTION CIRCUIT DESCRIPTION

5.13 The Model 3162 receive section measures test signals within a 300 Hz to 3 kHz bandpass. During 2-wire operation, test signals applied to 2W SND & REC 4W SND connector J1, E1/E2, or TB1 pass through normally closed contacts of 4W/2W pushbutton S5 to reach the receive section. The send section output reaches the receive section via the same contacts of the 4W/2W pushbutton when a battery or calibration check is performed. During 4-wire operation, test signals reach the receive section directly via 4W REC connector J2, E3/E4 or TB1 and the send section is isolated from the receive section.

5.14 Engaging REC pushbutton S4 applies the receive section input signal to series connected transformer T2 primary and capacitor C8. Transformer T2 and capacitor C8 provide a balanced, dc blocked input for the receive section. During 4-wire operation, a signal applied to 4W REC connector J2, E3/E4, or TB 1 can pass through contacts of the 4W/2W pushbutton to reach transformer T2 and hence, pressing the REC pushbutton is not required.

5.15 600/900 pushbutton S6 selects the proper parallel resistance for transformer T2 secondary to reflect either 600 ohms or 900 ohms impedance into the receive section input circuit. When the 600/900 pushbutton is in the

900 position, amplifier U2A's voltage gain is reduced from approximately 1.3 to 1.0 thereby allowing proper operation when testing 900-ohm telephone circuits.

5.16 Amplifier U2A's output goes to full-wave average detector U3. The full-wave average detector produces a positive dc voltage proportional to the input signal level being received. Offset adjust control R45 sets the average detector's output for the proper amplitude when a −30 dBm signal is applied to the test set. The full-wave average detector's output can be monitored at test point TP2.

5.17 The full-wave average detector's output goes to temperature compensated log converter U4/Q1/RT1. The log converter provides an output that varies linearly as its input varies logarithmically. This allows use of equidistant markings on the front panel meter.

5.18 The log converter output varies inversly with its input. That is, as the average detector's output becomes more positive, the log converter's output becomes more negative. Zero adjust control R36 sets the log converter's output such that a −29 dBm test set input level produces a −29 dBm reading on the front panel meter. The log converter output can be monitored at test point TP3.

5.19 The log converter's output goes to amplifier U2B. Amplifier U2B provides current drive for front panel meter M1. Full scale adjust control R37/R38 sets amplifier U2B's output current such that a +10 dBm test set input level produces a +10 dBm reading (full scale) on the front panel meter. Meter M1's full scale current is 100 uA. The voltage across full scale adjust control R37/R38 can be monitored at test point TP4.

5.20 POWER CIRCUIT DESCRIPTION

5.21 Either an external dc source from 42 to 56 volts (such as central office battery) or an internal battery supply can serve as the power source for the Model 3162. The circuits shown at the bottom of Figure 7−1 use one of these sources to produce the complimentary voltages required by the send and receive sections.

5.22 The external dc source connected to the rear panel terminal board's POWER terminals passes through diode steering bridge CR12-15. The diode sterring bridge provides an output voltage having a polarity that is independent of the polarity at its input. Hence, the Model 3162 is insensitive to the polarity of the terminal board's GND terminal with respect to the −48V terminal. A 1/32 ampere slow-blow fuse protects against excessive current in the line from the external source.

5.23 A standard series pass regulator circuit follows the steering bridge. This regulator circuit provides approximately 32 volts at its output for test set inputs from 42 to 56 volts.

5.24 The 32-volt output from regulator Q2/CR20 reverse biases diode CR17 since the internal battery supply provides 27 volts. Hence, the internal battery supply is automatically disabled when an external source is connected to terminal board TB1. If the external source is less than 40 volts (or removed) however, the 32-volt regulator output drops and diode CR17 becomes forward biased. This action allows the internal battery supply to serve as the test set power source. Diode CR17 prevents the regulator circuit from consuming current from the battery supply.

5.25 Power is supplied to the send and receive sections when any of the following pushbuttons are pressed: +7 DBM switch S1, 0 DBM switch S2, −16 DBM switch S3, or REC switch S4. Pressing any one of these pushbuttons applies power to voltage divider network R42/R43. As shown on Figure 7−1, the voltage divider produces complimentary output voltages required by the test set. The complimentary voltages produced are approximately ±16V for operation from an external source and approximately ±13.5V for operation from batteries in good condition. The test set will operate normally from voltages as low as ±9V (indicating battery voltage dropping to 18V).

5.26 The 32-volt regulator draws approximately 0.5 mA of current from an external source when the send and receive sections are de-energized (switches S1, S2, S3 and S4 are all released).

SECTION 6

MAINTENANCE

6.1 This section contains maintenance and calibration information for the Model 3162 Transmission Test Set.

6.2 FUSE REPLACEMENT

6.3 The Model 3162 contains a 1/32- ampere slow-blow fuse to protect against excessive current in the line from an external power source. To check/replace this fuse perform the following steps.

1. Remove any telephone or power lines from the test set.

2. Loosen two captive screws at rear of test set.

3. Remove test set from case by pushing forward on rear panel terminal board.

4. Fuse is located at rear of test set printed circuit board under battery tray. Inspect and replace as necessary.

5. Slide test set into case and hand tighten captive screws to reassemble unit.

6.4 BATTERY REPLACEMENT

6.5 The Model 3162 contains a battery supply consisting of three series connected 9-volt batteries. The condition of these batteries can be tested as described on the test set front panel with no external power source connected to the terminal board at the rear of the unit. If defective batteries are suspected, they can be replaced as described in the following steps.

1. Remove any telephone lines from the test set.

2. Loosen two captive screws at rear of test set.

3. Remove test set from case by pushing forward on rear panel terminal board.

4. Battery tray is located at the top rear of unit.

5. Remove tape applied across top of batteries.

6. Replace batteries with three 216-type 9V batteries. Be sure each battery is properly attached to its connector.

7. Replace tape across top of batteries. If condition of tape has deteriorated, replace with new tape of suitable type.

8. Before reassembling unit, perform battery test as indicated on front panel of test set. If battery test is not performed successfully, perform calibration procedure as described in paragraph 6.6.

9. If battery test is performed successfully, slide test set into case and hand tighten captive screws.

6.6 CALIBRATION PROCEDURE

6.7 The Model 3162 Transmission Test Set should be calibrated at intervals according to the user's practices for transmission test sets, or at intervals of approximately one year. The Model 3162 should also be calibrated whenever misalignment is suspected. The following calibration procedure can also be used as a performance check and troubleshooting aid.

6.8 To disassemble the test set for calibration disconnect any telephone lines from the unit and loosen two captive screws at the rear of the unit. Push forward on the rear panel terminal board to remove test set from case. Refer to Table 6—1 for equipment required to calibrate the Model 3162. Refer to Figure 7—3 to locate components on the Model 3162 printed circuit board.

6.9 If, during calibration of the test set, the unit is to be powered from its own battery supply, the battery condition must be checked before beginning the calibration procedure. If the test set is out of alignment, if may not be possible to accurately check the battery condition per the procedure given on the front panel. When this is the case, monitor quick disconnect pins 9 and 14 on the unit's pc board with a dc voltmeter while pressing both the +7 DBM and REC pushbuttons. If the batteries are in good condition, pin 9 should be approximately +27 volts with respect to pin 14 as observed on the dc voltmeter.

6.10 If, during calibration of the test set, the unit is to be powered from an external dc source between 42 and 56 volts, connect the source to the rear panel POWER terminals and observe the following caution.

CAUTION

If calibrating/troubleshooting the Model 3162 with an external source used to power the unit, all ground leads between test equipment and the Model 3162 must be isolated from the NEMA ground lead(s) in the test equipment power cord(s). Failure to observe this precaution can result in serious damage to the test set.

Table 6—1. Required Calibration Equipment.

EQUIPMENT	USE
Fluke Model 8000A digital multimeter or equivalent	Measure dc voltages to ± 1mV.
HP Model 200CD audio oscillator or equivalent	Provide a 1-kHz test signal with 600-ohm output impedance.
HP Model 400FL ac voltmeter or equivalent	Measure test signals from −30 to +10 dBm into 600 ohms.

6.11 SEND SECTION CALIBRATION

6.12 To calibrate the test set's send section perform the following steps.

1. Set 600/900 pushbutton S1 to 600.

2. Connect a 600-ohm, 1%, resistor across the ac voltmeter input terminals.

3. Connect the ac voltmeter to the 2W SND & REC 4W SND jack or binding posts.

4. Press 0 DBM pushbutton S2. Ac voltmeter should read 0 dB ± 0.3 dB. If not, adjust potentiometer R3 (shown on Figure 7—3) to obtain this reading.

5. Release 0 DBM pushbutton and remove 600-ohm resistor from ac voltmeter input terminals.

6.13 RECEIVE SECTION CALIBRATION

6.14 To caibrate the test set's receive section perform the following steps.

1. Check the front panel meter's mechanical zero. The meter should indicate −30 dBm with no input to the test set. If not, adjust screw on front of meter accordingly.

2. Check to be sure ac voltmeter is still connected across 2W SND & REC jack or binding posts.

3. Set audio oscillator to 1 kHz at minimum amplitude and connect across ac voltmeter terminals.

4. Condition digital multimeter to measure dc volts and connect between test points TP2 and TP5 on Model 3162 pc board.

5. Press the REC pushbutton. Adjust oscillator amplitude to obtain a +10 dB reading on the ac voltmeter.

6. While holding REC pushbutton, note reading on digital multimeter. It should read approximately 4.5 Vdc.

7. While holding REC pushbutton, adjust oscillator amplitude to obtain a −30 dB reading on the ac voltmeter.

8. With the REC pushbutton engaged, the digital multimeter should read 1/100 of the reading obtained in step 6 (±1mV). For example, if the reading obtained in step 6 was 4.5 Vdc, the digital multimeter should now read 45 ± 1 mVdc. If the digital voltmeter does not read properly, adjust potentiometer R45 accordingly.

9. While holding the REC pushbutton, adjust audio oscillator amplitude to obtain a −29 dB reading on the ac voltmeter.

10. With the REC pushbutton engaged, the test set front panel meter should read −29 dBm. If not, adjust potentiometer R36 accordingly.

11. While holding the REC pushbutton, adjust audio oscillator amplitude to obtain a +10 dB reading on the ac voltmeter.

12. With the REC pushbutton engaged, the test set front panel meter should read +10 dB. If not, adjust potentiometer R37 accordingly. Release the REC pushbutton.

13. This completes the calibration procedure for the Model 3162. Disconnect all test equipment from the test set and slide test set into case. Hand tighten captive screws.

6.15 **TROUBLESHOOTING**

6.16 The circuit descriptions of section 5, along with the diagrams of section 7 provide assistance for troubleshooting the Model 3162 Transmission Test Set. The calibration procedure given in paragraph 6.6 of this section contains information useful for troubleshooting. The calibration procedure can be used as a performance check for the test set.

CAUTION

If calibration/troubleshooting the Model 3162 when an external source is used to power the unit, all ground leads between test equipment and the Model 3162 must be isolated from the NEMA ground lead(s) in the test equipment power cord(s). Failure to observe this precaution can result in serious damage to the test set.

SECTION 7

DIAGRAMS

7.1 This section contains diagrams for the Model 3162 Transmission Test Set. Figure 7—1 is a block diagram. Figures 7—2 and 7—3 are component location diagrams that show locations of all electronic parts and assemblies. Figure 7—4 is a detailed schematic diagram for the test set.

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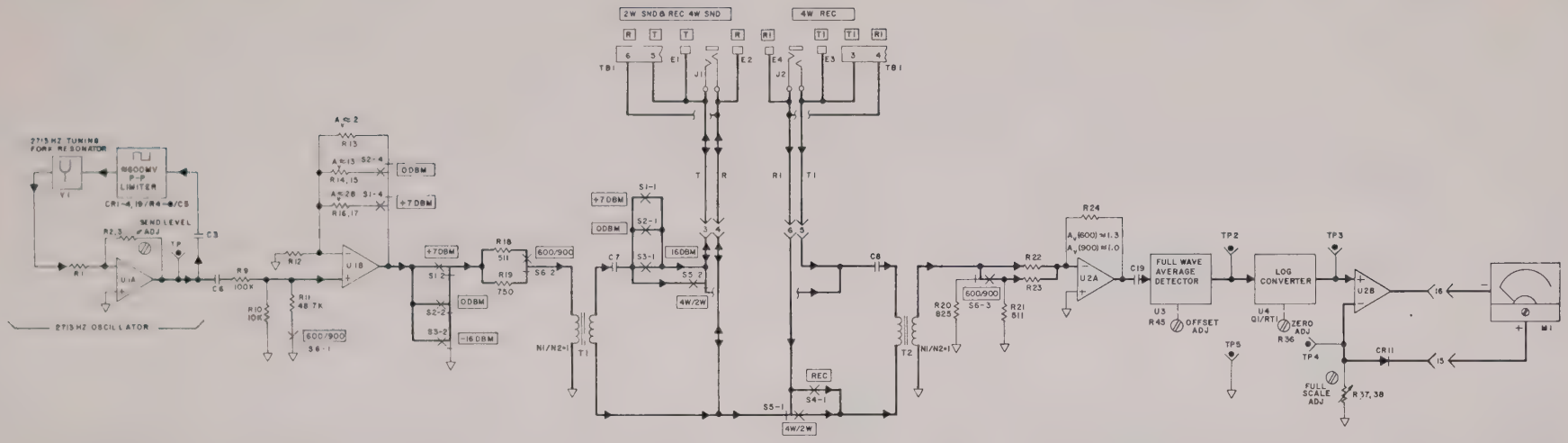

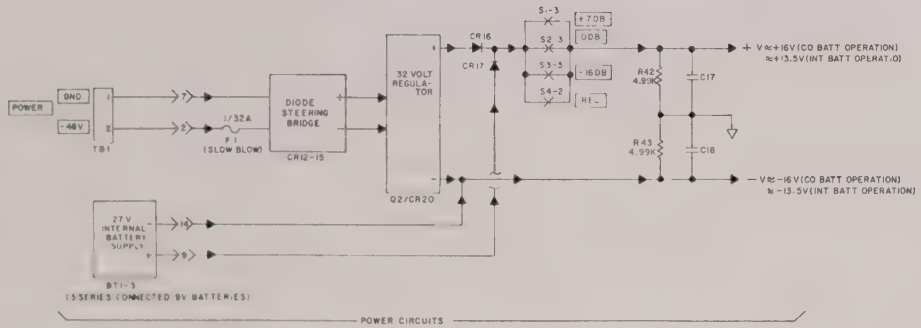

NOTES

1. MODEL 3162 ELECTRONIC CIRCUITS ARE LOCATED ON PC BOARD 96707 A1
2. NUMBERED QUICK DISCONNECT PINS SHOWN, INTERCONNECT PC BOARD 96707 TO FRONT & REAR PANEL CONNECTORS, METER & INTERNAL BATTERY SUPPLY
3. SOME MODELS MAY BE EQUIPPED WITH A SPECIALLY ORDERED 1004 HZ TUNING FORK RESONATOR TO PRODUCE A 1004 HZ SEND FREQUENCY

Figure 7–1. Model 3162 Block Diagram.

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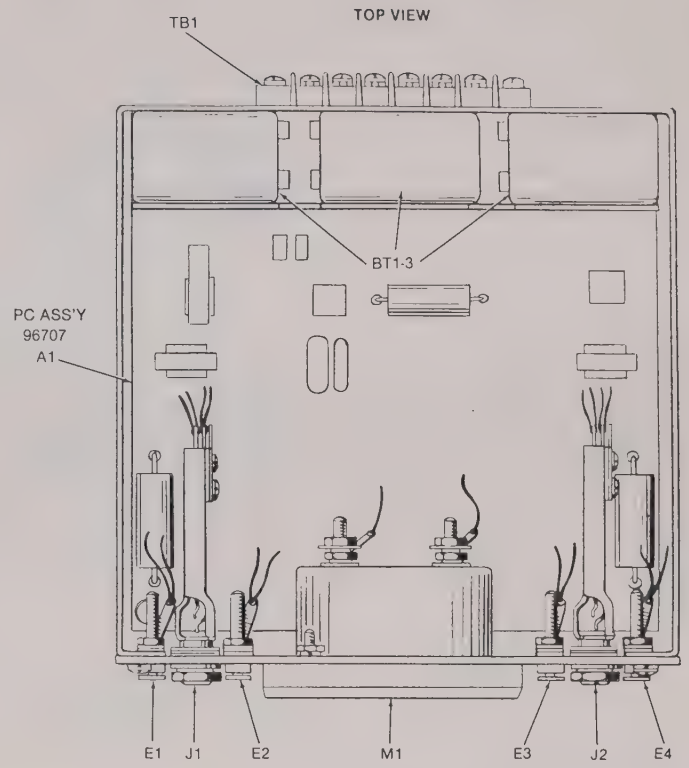


Figure 7—2. Model 3162 Overall Component Location Diagram.

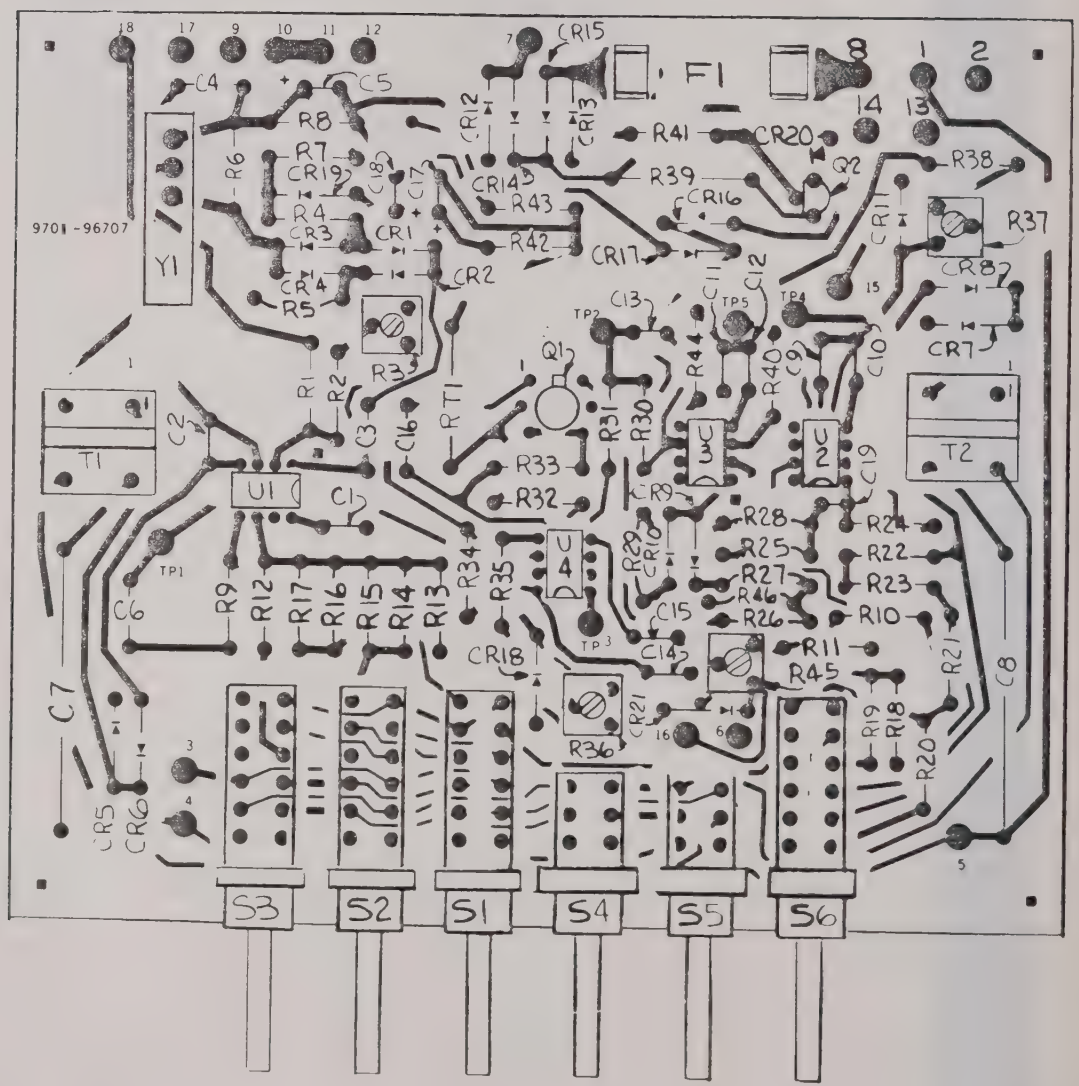
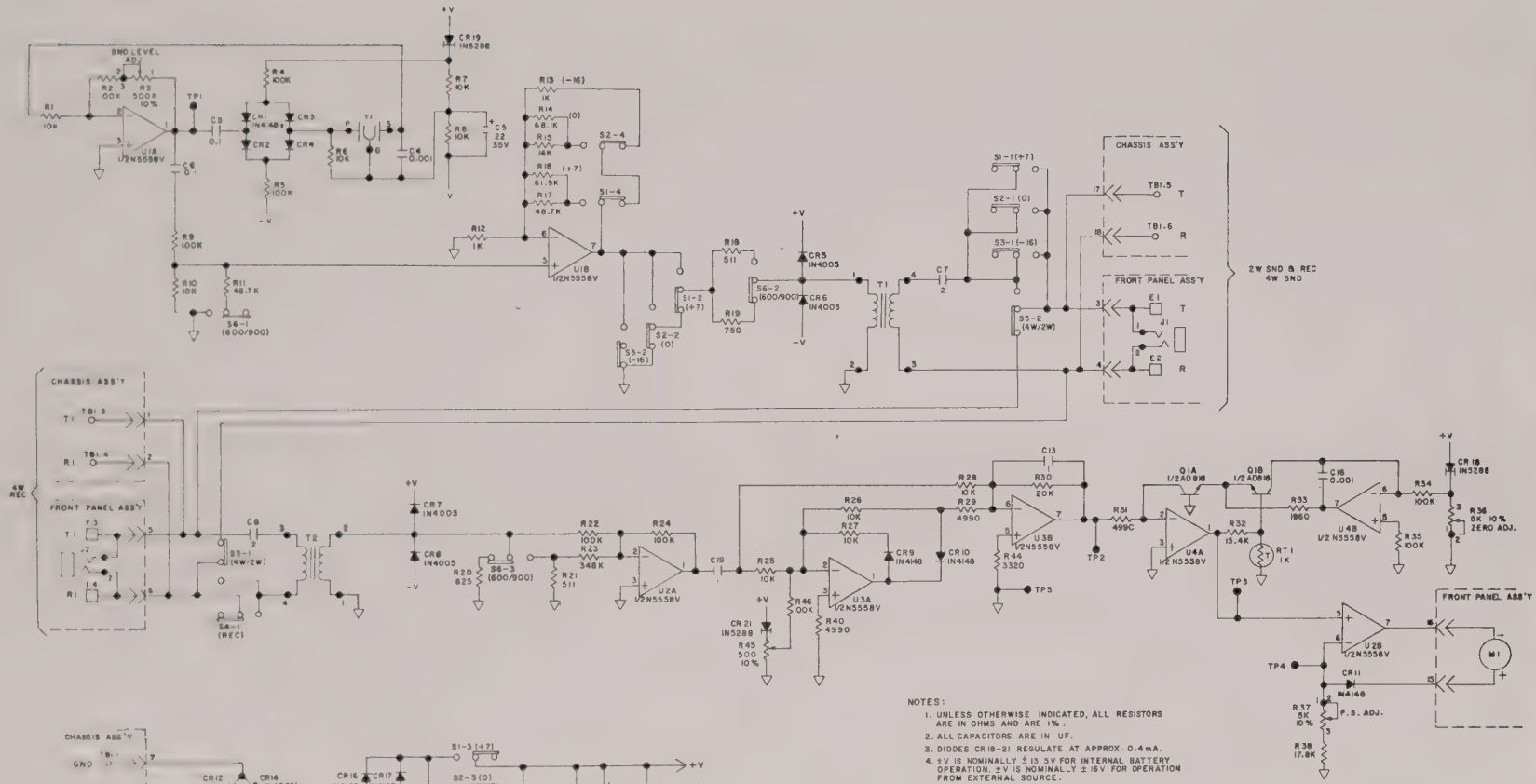


Figure 7—3. PC Assembly 96707 Component Location Diagram.



NOTES:

1. UNLESS OTHERWISE INDICATED, ALL RESISTORS ARE IN OHMS AND ARE 1%.
2. ALL CAPACITORS ARE IN UF.
3. DIODES CR18-21 REGULATE AT APPROX. 0.4 mA.
4. +V IS NOMINALLY ± 13.3V FOR INTERNAL BATTERY OPERATION. ±V IS NOMINALLY ± 16V FOR OPERATION FROM EXTERNAL SOURCE.

HIGHEST REFERENCE DESIGNATIONS		
R46	C19	CR21
U4	Q2	

IC	TYPE	+V	-V
U1-4	N5558V	8	4

MODEL 3162	PC ASSY
NEC PART NO	C3162-00-012
REF DESIG	A1
PC NO	96707

Figure 7—4. Model 3162 Schematic Diagram.

SECTION 8

ELECTRONIC PARTS LISTS

8.1 This section contains electronic parts lists (Tables 8—1 and 8—2) for the Model 3162 Transmisison Test Set. Figures 7—2 and 7—3 show locations and reference designations for all electronic assemblies and parts.

Table 8—1. Model 3162 Overall Assembly Parts List.

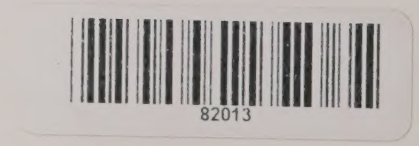
REFERENCE DESIGNATOR	DESCRIPTION VALUE	POWER	TOL	VOLTS	MFGR.	MFGR. PART NO.	N.E.C. PART NO.
A1	PRACTICAL ASSY 96707						A316200012
E1-4	CLIP POST						A012500107
J1-2	MT332B				SWCRFT	5J-1583	650403100
M1	METER,L.T.U. 3162				LFE	7025/SPECIAL	901100403
TB1	STRIP,BARRIER,6 CONTACT				CINCH	6-140Y	650003000
BT1-3	BATT C/Z MIN SNAP				EVEREADY	216	910001100

Table 8—2. Printed Circuit Assembly 96707 (A1, A3162-00-012) Parts List.

REFERENCE DESIGNATOR	DESCRIPTION VALUE	POWER	TOL	VOLTS	MFGR.	MFGR. PART NO.	N.E.C. PART NO.
C1-2	.01UF		00	50V	CENTRALAB	CK-103	330701030
C3	.1UF		10%	100V	SPRAGUE	225P10491WD3	320001040
C4	.001UF		10%	100V	SPRAGUE	225P10291WD3	320001020
C5	22UF	F	20%	35V	SPRAGUE	196D226X0035PE4	310802261
C6	.1UF		10%	100V	SPRAGUE	225P10491WD3	320001040
C7-8	2UF		10%	100V	F-DYNE	MPC12-2.0-100-10	321802050
C9-12	.01UF		00	50V	CENTRALAB	CK-103	330701030
C13	1.0UF	Y5V	TC 20%	50V	ERIE	8131-050-651-105M	330801050
C14-15	.01UF		00	50V	CENTRALAB	CK-103	330701030
C16	.001UF		10%	100V	SPRAGUE	225P10291WD3	320001020
C17-18	22UF	F	20%	35V	SPRAGUE	196D226X0035PE4	310802261
C19	1.0UF	Y5V	TC 20%	50V	ERIE	8131-050-651-105M	330801050
CR1-4	D035	500MW		75V	FAIRCHILD	1N4148	560041480
CR5-8	D041			600V	EDAL	1N4005	560040050
CR9-11	D035	500MW		75V	FAIRCHILD	1N4148	560041480
CR12-15	D041			600V	EDAL	1N4005	560040050
CR16-17	D035	500MW		75V	FAIRCHILD	1N4148	560041480
CR18-21	CASE 51	.39MA			MOTOROLA	1N5288	560005288
F1	FUSE SLO-BLO				BUSSMAN	MDL	863101300
PC1	LTU ACTIVATOR						970196707
Q1	TO-52	NPN			ANALOG DEV	AD818	500000818
Q2	TO92	310MW		20V	MOTOROLA	MPSA12	550000120
R1	10K	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220210021
R2	100K	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220210031
R3	500K	1/2W	10%		HELIPOT	72PMR500K	232705043
R4-5	100K	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220210031
R6-8	10K	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220210021
R9	100K	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220210031
R10	10K	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220210021
R11	48.7K	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220248721
R12-13	1000-	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220210011
R14	68.1K	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220268121
R15	14K	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220214021
R16	61.9K	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220261921
R17	48.7K	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220248721
R18	511-	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220251101
R19	750-	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220275001

Table 8—2. (cont'd).

REFERENCE DESIGNATOR	DESCRIPTION VALUE	POWER	TOL	VOLTS	MFGR.	MFGR. PART NO.	N.E.C. PART NO.
R20	825-	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220282501
R21	511-	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220251101
R22	100K	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220210031
R23	348K	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220234831
R24	100K	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220210031
R25-28	10K	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220210021
R29	4990-	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220249911
R30	20K	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220220021
R31	4990-	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220249911
R32	15.4K	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220215421
R33	1960-	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220219611
R34-35	100K	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220210031
R36-37	5K	1/2W	10%	200V	HELIPOT	72PMR5K	232705023
R38	17.8K	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220217821
R39	300Ω	3W	5%		W LEONARD	TYPE 3X	210303015
R40	4990-	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220249911
R41	82.5K	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220282521
R42-43	4990-	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220249911
R44	3320-	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220233211
R45	500-	1/2W	10%	200V	HELIPOT	72PMR500	232705010
R46	100K	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220210031
RT1	1K	3W	1%		TEL LABS	Q81 1000 OHMS	211510011
S1-3	4PDT-MOMENTARY				CRL	PB-1	635900150
S4	DPDT-MOMENTARY				CRL	PB-1	635900100
S5	2C				CRL	2KAB010000XXX	635800700
S6	4C				CRL	2KAB001000XXX	635800800
T1-2	P600 - S 600 PC MTG.				MICROTRAN	T2104	400300001
U1-4	8PDIL	80MW		180	SIGNETICS	N5558V	500055580
XF1	3AG				LITTELFUSE	102069	863300300
Y1	2713 HZ				BRAMCO	A01938-27130	470100701



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